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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
MURPHY, RHONDA L	

ART UNIT	PAPER NUMBER
2462	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	**Application No.** 10/788,657	**Applicant(s)** SHAO ET AL.	
	Examiner RHONDA MURPHY	**Art Unit** 2462	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *13 May 2011*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *30-44* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *30-44* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *27 February 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

12)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 5/13/11 has been entered.

2. Accordingly, claims 1-29 have been canceled and claims 30-44 are pending.

Response to Arguments

3. Applicant's arguments with respect to claims 30, 35 and 40 have been considered but are moot in view of the new ground(s) of rejection.

4. The terminal disclaimer has been received and is held in abeyance until approval by the Office.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 30 - 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Boariu et al. (US 6,865,237) in view of Wallace et al. (US 6,473,467) and Giannakis et al. (US 7,224,744).

Regarding claims 30 and 35, Boariu teaches an apparatus (*Fig. 3*) comprising: a diversity agent (*Fig. 3: transmitter 300*): to receive content from a wireless communication system having M transmit antennae (*314,316,318*) and N receive antennae (*322 - only one illustrated, however the system can be configured to have multiple receive antennae - col. 23, lines 63-64; further described in col. 18-19; col. 29, lines 64-65*) and Nc subcarrier (*col. 12, lines 60-66*), the received content for transmission via a multicarrier wireless communication channel of the wireless communication system (*see Fig. 3; col. 12, lines 31-37*), wherein the received content is a vector of input symbols (s) of size Nc x 1, and wherein the Nc subcarriers is the number of subcarriers of the multicarrier wireless communication channel (*col. 12, lines 60-66*); and to generate a rate-one, space-

frequency code matrix from the received content for transmission on the multicarrier wireless communication channel from more than two of the M transmit antennae (*col. 12, lines 44-53*).

Boariu fails to explicitly disclose where Nc>>M,N.

However, Wallace teaches the number of subcarriers being greater than the number of antennas (*col. 11, lines 63-64*).

In view of this, it would have been obvious to one skilled in the art at the time the invention was made, to modify Boariu's system by incorporating the teachings of Wallace, for the purpose of obtaining a desired antenna and frequency diversity (*col. 12, lines 2-4*).

Boariu fails to explicitly disclose dividing the vector of input symbols into a number G of groups to generate subgroups and multiplying at least a subset of the subgroups by a constellation rotation precoder to produce a number G of pre-coded vectors (vg), wherein successive symbols from the same group transmitted from the same antenna are at a frequency distance that is multiples of MG subcarrier spacings, wherein M represents a number of transmit antennae.

However, Giannakis teaches dividing the vector of input symbols into a number G of groups to generate subgroups and multiplying at least a subset of the subgroups by a constellation rotation precoder to produce a number G of pre-coded vectors (Vg) (*col. 9, lines 1-15; col. 10, lines 15-23*), wherein successive symbols from the same group transmitted from the same antenna are at a

frequency distance that is multiples of NG subcarrier spacings (*col. 10, lines 24-42*).

In view of this, it would have been obvious to one skilled in the art to divide the symbols into groups and multiply by a constellation rotation precoder, in order to reduce decoding complexity without sacrificing diversity or coding gains (Giannakis: col. 8, lines 60-61).

Regarding claims 31 and 36, the combined system of Boariu, Wallace, Giannakis and Csapo teach a method according to claim 30.

Boariu fails to explicitly disclose dividing each of the pre-coded vectors into a number of LM x 1 subvectors, and to create an M x M diagonal matrix = Dsg,k = diag{ΘTM×(k-1)+1Sg ,..., ΘTMxkSg }, where k=1...L from the subvectors.

However, Giannakis further teaches dividing each of the pre-coded vectors into a number of LM x 1 subvectors, and to create an M x M diagonal matrix = Dsg,k = diag{ΘTM×(k-1)+1Sg ,..., ΘTMxkSg }, where k=1...L from the subvectors (col. 9, lines 45-60; col. 10, lines 15-23).

In view of this, it would have been obvious to one skilled in the art at the time the invention was made, to modify Boariu's system by incorporating the teachings of Giannakis, for the purpose of providing maximum diversity (col. 9, lines 11-12).

Regarding claims 32 and 37, the combined system of Boariu, Wallace, Giannakis and Csapo teach a method according to claim 31.

Boariu fails to explicitly disclose interleaving the L submatrices from the G groups to generate an M x Nc space-frequency matrix.

However, Giannakis further interleaving the L submatrices from the G groups to generate an M x Nc space-frequency matrix (col. 9, lines 32-55).

In view of this, it would have been obvious to one skilled in the art at the time the invention was made, to modify Boariu's system by incorporating the teachings of Giannakis, for the purpose of providing maximum diversity (col. 9, lines 11-12).

Regarding claims 33 and 38, Boariu teaches a method according to claim 32, wherein the space-frequency matrix (col. 12, lines 44-50) provides MNL channel diversity, while preserving a code rate of 1 for any number of the transmit antennae M, receive antenna(s) N and channel tap(s) L (col. 12, lines 51-63).

Regarding claims 34 and 39, Boariu teaches a method according to claim 30, wherein the space-frequency matrix (col. 12, lines 44-50) provides MNL channel diversity, while preserving a code rate of 1 for any number of the transmit antennae M, receive antenna(s) N and channel tap(s) L (col. 12, lines 51-63).

4. Claims 40 – 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Boariu et al. (US 6,865,237) in view of Wallace et al. (US 6,473,467), Giannakis et al. (US 7,224,744) and Csapo et al. (US 6,801,788).

Regarding claim 40, Boariu teaches a wireless communication system (*Fig. 3*) comprising: a number M of bi-directional antennas, wherein M comprises more than two bi-directional antennas (*antennas 314, 316, 318*); a number N of receive

antennae (*322 - only one illustrated, however the system can be configured to have multiple receive antennae - col. 23, lines 63-64; further described in col. 18-19; col. 29, lines 64-65*); a number Nc of subcarriers of a multicarrier wireless communication channel of the wireless communication system (*see Fig. 3; col. 12, lines 31-37, 60-66*); and a diversity agent: to receive content for transmission via the multicarrier wireless communication channel (*elements within transmitter 300*), wherein the received content is a vector of input symbols (s) of size Nc x 1, and to generate a rate-one, space-frequency code matrix from the received content for transmission on the multicarrier wireless communication channel from at least a subset of the M bi-directional antennas (*col. 12, lines 44-53*).

Boariu fails to explicitly disclose where Nc>>M,N.

However, Wallace teaches the number of subcarriers being greater than the number of antennas (*col. 11, lines 63-64*).

In view of this, it would have been obvious to one skilled in the art at the time the invention was made, to modify Boariu's system by incorporating the teachings of Wallace, for the purpose of obtaining a desired antenna and frequency diversity (*col. 12, lines 2-4*).

Boariu fails to explicitly disclose dividing the vector of input symbols into a number G of groups to generate subgroups and multiplying at least a subset of the subgroups by a constellation rotation precoder to produce a number G of pre-coded vectors (vg), wherein successive symbols from the same group transmitted from the same antenna are at a frequency distance that is multiples of MG subcarrier spacings.

However, Giannakis teaches dividing the vector of input symbols into a number G of groups to generate subgroups and multiplying at least a subset of the subgroups by a constellation rotation precoder to produce a number G of pre-coded vectors (Vg) (*col. 9, lines 1-15; col. 10, lines 15-23*), wherein successive symbols from the same group transmitted from the same antenna are at a frequency distance that is multiples of NG subcarrier spacings (*col. 10, lines 24-42*).

In view of this, it would have been obvious to one skilled in the art to divide the symbols into groups and multiply by a constellation rotation precoder, in order to maximize spatial diversity.

Although Boariu teaches bi-directional antennas, Boariu fails to explicitly disclose omnidirectional antennas.

However, Csapo teaches omnidirectional antennas (*col. 1, lines 49-54*). In view of this, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Boariu's system to include omnidirectional antennas, for the purpose of enabling the antennas to transmit and receive signals in all directions.

Regarding claim 41, the combined system of Boariu, Wallace, Giannakis and Csapo teach a wireless communication system according to claim 40.

Boariu fails to explicitly disclose the diversity agent further comprising: a space-frequency encoding element, responsive to the pre-coder element, to divide each of the pre-coded vectors into a number of LM x 1 subvectors, and to

create an M x M diagonal matrix = Dsg,k = diag{ΘTM×(k-1)+1Sg ,..., ΘTMxkSg }, where k=1...L from the subvectors.

However, Giannakis further teaches the diversity agent further comprising: a space-frequency encoding element, responsive to the pre-coder element, to divide each of the pre-coded vectors into a number of LM x 1 subvectors, and to create an M x M diagonal matrix = Dsg,k = diag{ΘTM×(k-1)+1Sg ,..., ΘTMxkSg }, where k=1...L from the subvectors (col. 9, lines 45-60; col. 10, lines 15-23).

In view of this, it would have been obvious to one skilled in the art at the time the invention was made, to modify Boariu's system by incorporating the teachings of Giannakis, for the purpose of providing maximum diversity (col. 9, lines 11-12).

Regarding claim 42, the combined system of Boariu, Wallace, Giannakis and Csapo teach a wireless communication system according to claim 41.

Boariu fails to explicitly teach wherein the space-frequency encoding element interleaves the L submatrices from the G groups to generate an M x Nc space-frequency matrix.

However, Giannakis further teaches wherein the space-frequency encoding element interleaves the L submatrices from the G groups to generate an M x Nc space-frequency matrix (col. 9, lines 32-55).

In view of this, it would have been obvious to one skilled in the art at the time the invention was made, to modify Boariu's system by incorporating the teachings of Giannakis, for the purpose of providing maximum diversity (col. 9, lines 11-12).

Regarding claim 43, Boariu teaches a wireless communication system according to claim 42, wherein the space-frequency matrix (col. 12, lines 44-50) provides MNL channel diversity, while preserving a code rate of 1 for any number of the transmit antennae M, receive antenna(s) N and channel tap(s) L (col. 12, lines 51-63).

Regarding claim 44, Boariu teaches a wireless communication system according to claim 40, wherein the space-frequency matrix (col. 12, lines 44-50) provides MNL channel diversity, while preserving a code rate of 1 for any number of the transmit antennae M, receive antenna(s) N and channel tap(s) L (col. 12, lines 51-63).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to RHONDA MURPHY whose telephone number is (571)272-3185. The examiner can normally be reached on Monday - Friday 9:00 - 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Seema Rao can be reached on (571) 272-3174. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public

PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Rhonda Murphy/
Examiner, Art Unit 2462